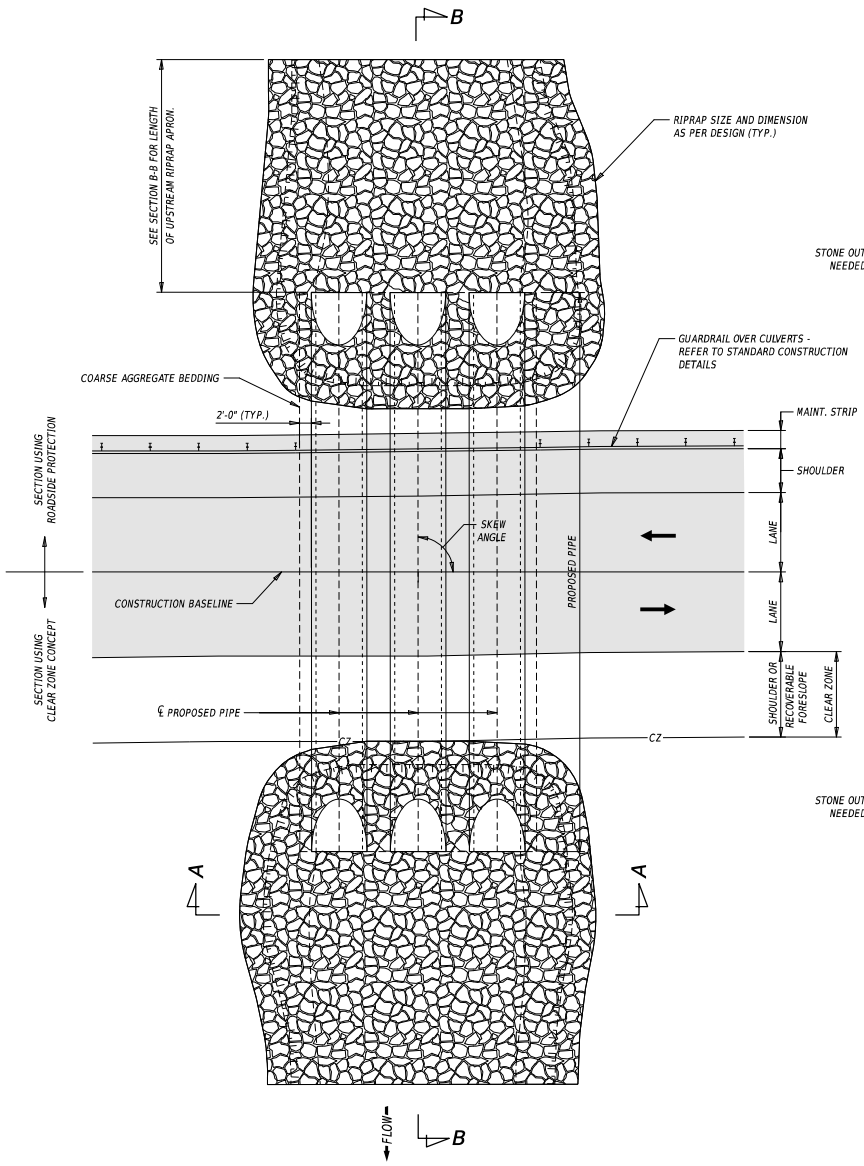
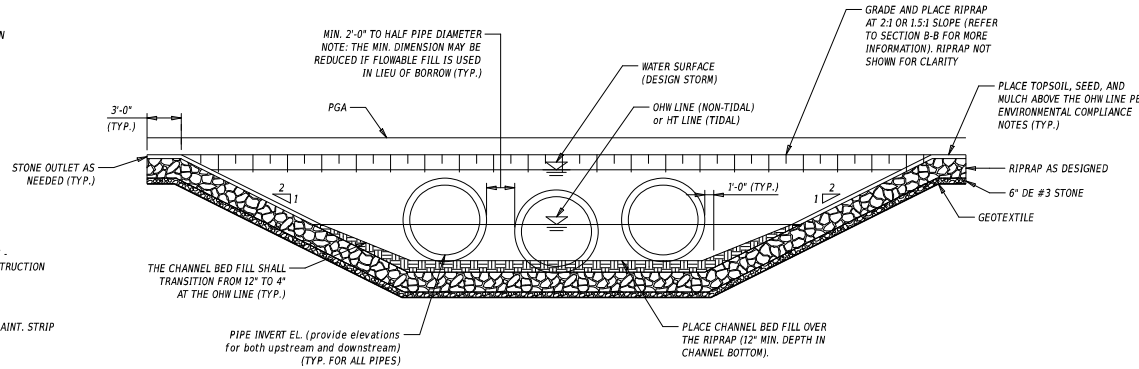
OHW = ORDINARY HIGH WATER
HT = HIGH TIDE

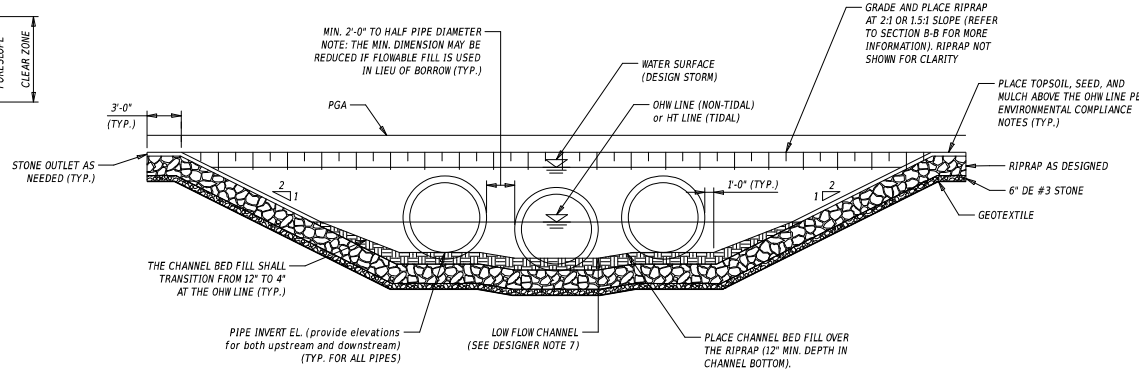


PLAN



SECTION A-A (WITHOUT LOW-FLOW CHANNEL CONSTRUCTED IN RIPRAP)

NOTE: REFER TO PROJECT SPECIFIC ENVIRONMENTAL COMPLIANCE SHEET(S) FOR FURTHER INFORMATION ON RIPRAP AND TOPSOIL TREATMENT. GUARDRAIL OVER CULVERTS NOT SHOWN FOR CLARITY. FOR MORE INFORMATION ON PIPE INVERTS, SEE DESIGNER NOTE 9.



SECTION A-A (WITH LOW-FLOW CHANNEL CONSTRUCTED IN RIPRAP)

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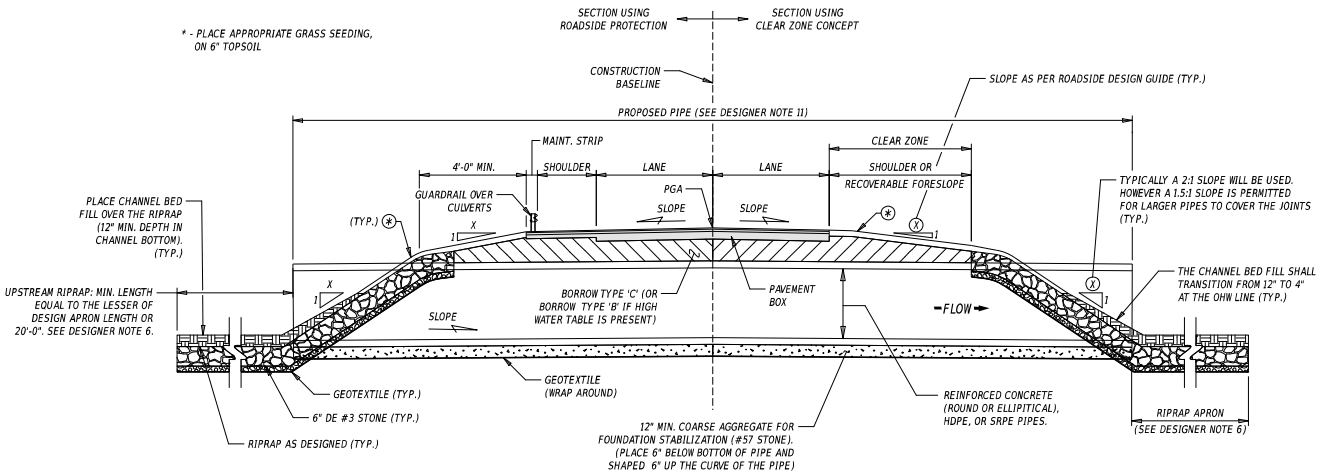
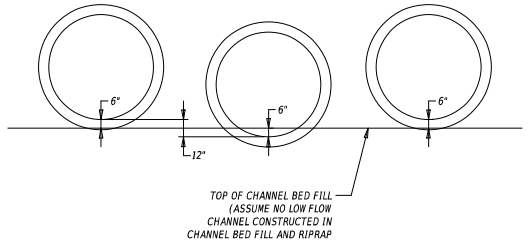


SECTION B-B



PIPE INVERT DIAGRAM

NOTE: IN CASES WHERE TWO PIPE RUNS ARE USED, ONE PIPE MAY MEET THE REQUIREMENTS OF THE CENTER PIPE AND THE OTHER MEET THE REQUIREMENTS OF THE SIDE PIPES AS SHOWED ABOVE. NOTE THAT NOT IN ALL INSTANCES WILL MULTIPLE RUNS OF PIPES DIFFER IN INVERT ELEVATIONS. CONSULT WITH THE ENVIRONMENTAL STUDIES SECTION FOR RECOMMENDED PIPE INVERTS.

TYPE	CONDITION	MINIMUM COVER (H_{min})
FLEXIBLE PIPE		
THERMOPLASTIC (HDPE) PIPE **	UNDER UNPAVED AREAS	S/8 ≥ 12-INCH *
	UNDER PAVED ROADS	S/2 ≥ 24-INCH *
STEEL-REINFORCED THERMOPLASTIC (SRPE) PIPE		S/5 ≥ 12-INCH *
RIGID PIPE		
REINFORCED CONCRETE PIPE ***	UNDER UNPAVED AREAS OR TOP OF FLEXIBLE PAVEMENT	S/8 ≥ 12-INCH (MEASURED FROM TOP OF FLEXIBLE PAVEMENT OR TOP OF GROUND) *
	UNDER RIGID PAVEMENT	9-INCH (MEASURED FROM BOTTOM OF RIGID PAVEMENT) *

NOTE:

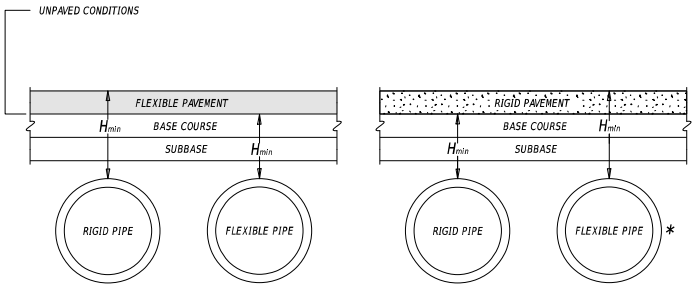
** SEE MINIMUM COVER ORIENTATION FOR MINIMUM COVER FOR RIGID AND FLEXIBLE PIPE.*

*** MAXIMUM INTERIOR PIPE DIMENSION ALLOWED FOR THERMOPLASTIC (HDPE) PIPES IS 60 INCHES.*

**** CLASS IV OR V REINFORCED CONCRETE PIPE MAY BE USED IN ACCORDANCE WITH AASHTO DESIGN STANDARDS WHERE THE COVER IS SHALLOWER THAN THE MINIMUM COVER FOR CLASS III. CLASS III IS THE MINIMUM ALLOWED BY DELDOT.*

WHERE: S = LARGEST INTERIOR PIPE DIMENSION (IN.)

MINIMUM COVER



H_{min} = MINIMUM ALLOWABLE COVER DIMENSION

NOTE: THE MINIMUM COVER DIMENSION IS NOT TO BE CONFUSED WITH THE FILL HEIGHT USED FOR CALCULATION PURPOSES, WHICH SHALL BE FROM THE TOP OF THE PIPE TO THE TOP OF THE SURFACE, REGARDLESS OF THE PIPE TYPE OR PAVEMENT TYPE.

**MINIMUM 3" BELOW RIGID PAVEMENT*

MINIMUM COVER ORIENTATION

DESIGNER NOTES

1. REINFORCED CONCRETE PIPES, THERMOPLASTIC (HDPE) PIPES, AND STEEL-REINFORCED THERMOPLASTIC (SRPE) PIPES SHALL BE MANUFACTURED AND INSTALLED IN ACCORDANCE WITH SECTION 601 OF THE STANDARD SPECIFICATIONS.
2. FOR MORE INFORMATION ON AVAILABLE PIPE SIZES, PLEASE REFER TO THE FOLLOWING:
   (a) AASHTO M170, AASHTO M207 OR ACPA CONCRETE DESIGN MANUAL FOR REINFORCED CONCRETE PIPES (CIRCULAR AND ELLIPTICAL).
   (b) AASHTO M294 FOR THERMOPLASTIC (HDPE) PIPES. HDPE PIPES SHALL BE LIMITED TO A MAXIMUM DIAMETER OF 60-INCHES.
   (c) AASHTO M294 TYPE D FOR STEEL-REINFORCED THERMOPLASTIC (SRPE) PIPES.
3. IF HDPE PIPES ARE USED ON A PROJECT, THE DESIGNER SHALL SPECIFY THE TYPE OF PIPE ON THE PLANS. SECTION 601 OF THE STANDARD SPECIFICATIONS LISTS SEVERAL TYPES OF HDPE PIPES THAT ARE PERMITTED IN DELAWARE.
4. IT IS RECOMMENDED THAT THE DESIGNER VERIFY THE AVAILABILITY FOR THE SELECTED PIPE TYPE AND SIZE BY CONTACTING THE LOCAL FABRICATORS.
5. THE HYDRAULIC CAPACITY OF PIPE CULVERTS SHALL BE DETERMINED IN ACCORDANCE WITH SECTION 104 - HYDROLOGY AND HYDRAULIC INVESTIGATIONS.
6. THE SIZE AND DIMENSION OF RIPRAP PROTECTION SHALL BE AS REQUIRED BY HYDRAULIC CALCULATIONS. FOR UPSTREAM OR DOWNSTREAM LIMITS, THE MINIMUM LENGTH MAY BE EXTENDED TO FIT FIELD CONDITIONS (BENDS, SCOUR HOLES, ETC.). THE MINIMUM SIZE OF RIPRAP IS R-4 IF BURIED AND R-5 IF EXPOSED. RIPRAP SHALL BE CONTOURED TO MATCH THE SHAPE OF THE EXISTING STREAM BANKS AT THE PROJECT LIMITS.
7. WHEN REQUIRED FOR ENVIRONMENTAL COMPLIANCE, A LOW FLOW CHANNEL SHALL BE CONSTRUCTED IN THE RIPRAP AND CHANNEL BED FILL. DIMENSIONS OF THE LOW FLOW CHANNEL ARE LOCATION SPECIFIC AND WILL BE PROVIDED BY THE ENVIRONMENTAL STUDIES SECTION.
8. THE PIPES AS SHOWN ON SHEET 1 ARE THREE CIRCULAR REINFORCED CONCRETE PIPES. THE USE OF ELLIPTICAL REINFORCED CONCRETE PIPES, HDPE PIPES, AND SRPE PIPES MAY BE CONSIDERED. THE MINIMUM NUMBER OF RUNS IS 1 AND THE MAXIMUM NUMBER OF RUNS IS 3.
9. THE INVERT OF THE CENTER PIPE SHALL BE RECESSED 6-INCHES BELOW THE STREAMBED ELEVATION (I.E. CHANNEL BED FILL ELEVATION). THE SIDE PIPES SHALL BE RAISED ABOVE THE INVERT OF THE CENTER PIPE BY A MINIMUM OF 12-INCHES. IF UNABLE TO COMPLY, COORDINATE WITH THE ENVIRONMENTAL STUDIES SECTION FOR EXCEPTION. REFER TO PIPE INVERT DIAGRAM FOR MORE INFORMATION.
10. LIMITS FOR POTENTIAL EXCAVATION OF UNSUITABLE MATERIAL IN SECTION B-B VIEW NOT SHOWN FOR CLARITY. FOR PROJECTS THAT REQUIRE EXCAVATION OF UNSUITABLE MATERIAL, SHOW LIMITS OF THE EXCAVATION AND SPECIFY TYPE(S) OF BACKFILL TO BE USED ON SECTION B-B VIEW.
11. THE TOTAL LENGTH OF PIPES SHOULD BE DESIGNED WITH THE FOLLOWING TYPICAL SECTION LENGTHS FOR THE MATERIALS LISTED BELOW:
   (a) REINFORCED CONCRETE PIPES: 8'-0" SECTIONS.
   (b) THERMOPLASTIC (HDPE) PIPES: 20'-0" SECTIONS. NOTE THAT LENGTHS LESS THAN 20'-0" CANNOT BE PLACED AS EXTERIOR SECTIONS DUE TO DURABILITY ISSUES.
   (c) STEEL-REINFORCED THERMOPLASTIC (SRPE) PIPES: 20'-0" OR 24'-0" SECTIONS. NOTE THAT LENGTHS LESS THAN 20'-0" CANNOT BE PLACED AS EXTERIOR SECTIONS DUE TO DURABILITY ISSUES.